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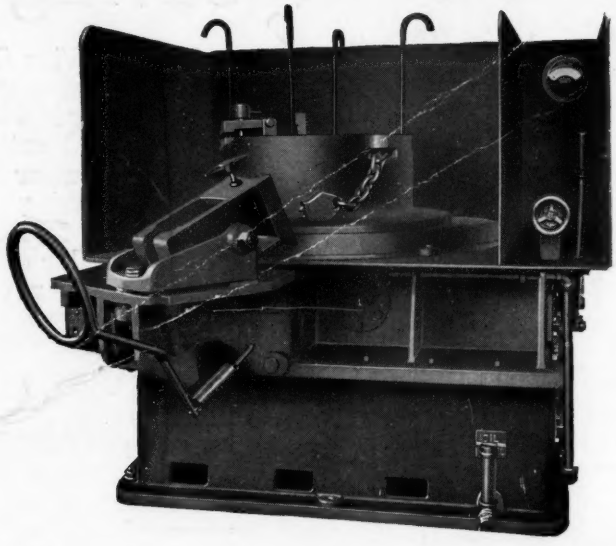

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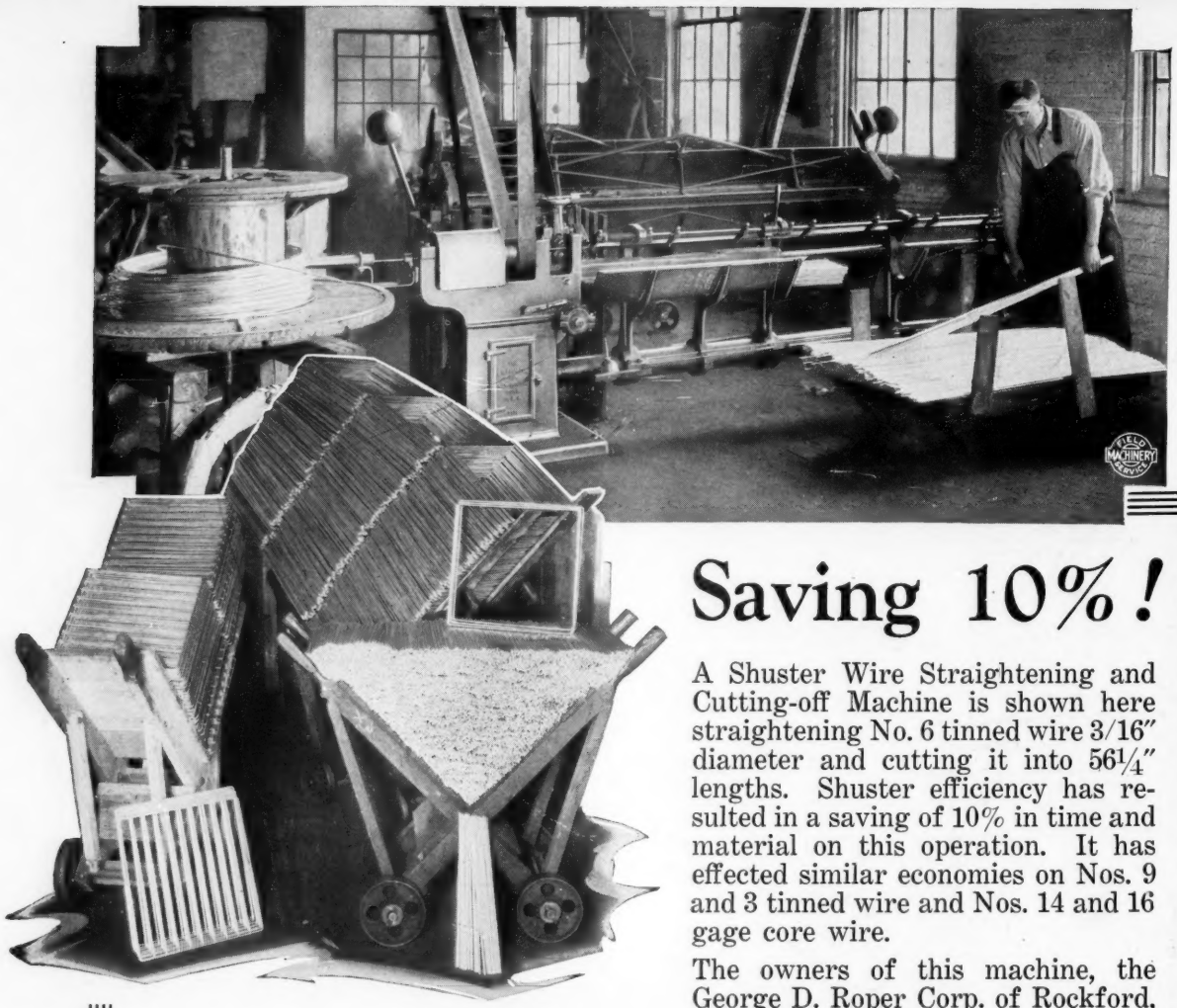

The wire on and leaning against the truck has just been straightened and cut on the Shuster. In the rear are some of the 56¼" pieces that have been bent into shape. At the left are finished oven racks—made from wire cut on the Shuster machine.

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A Shuster Wire Straightening and Cutting-off Machine is shown here straightening No. 6 tinned wire 3/16" diameter and cutting it into 56¼" lengths. Shuster efficiency has resulted in a saving of 10% in time and material on this operation. It has effected similar economies on Nos. 9 and 3 tinned wire and Nos. 14 and 16 gage core wire.

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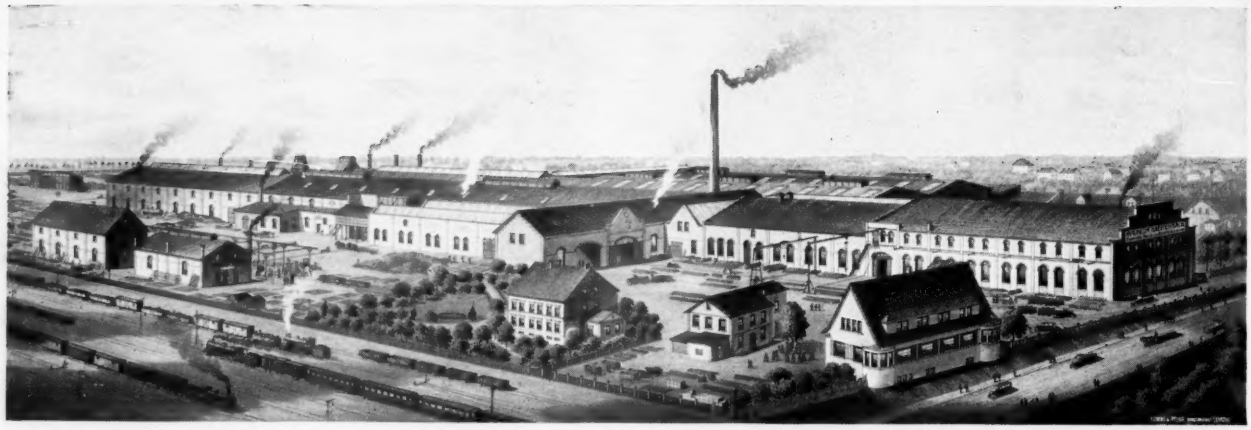

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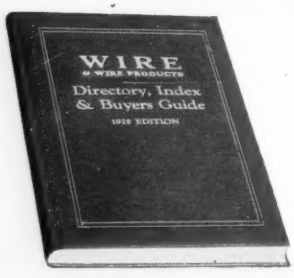

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JUST as a matter of curiosity, we made a count of the publications reviewed in one of the four-week periods between issues of *Wire & Wire Products.*

There were forty-eight.

* * *

This figure does not include newspapers or the miscellaneous printed matter that arrives in any business man's mail. It does include selected American and foreign scientific, technical and trade periodicals, and the reports of government departments, institutional and private laboratories, engineering societies and technical schools.

* * *

When all of this is reviewed, sifted and re-examined for its relation to the field we try to cultivate intensively, the gleanings are slight enough. Much goes to the slag heap, and we often have a trace of fellow-feeling for the mountain that labored to bring forth a mouse.

* * *

However, this constant skimming of the stream of technical and trade literature, supplemented by reviews of industrial catalogues, bulletins and the like builds up a fund of information that may be infrequently reflected in our pages and still be useful to readers who have specific inquiries to make.

* * *

The New Year brings with it new readers who are reminded that our interest in their business does not end with the receipt of their subscription order.

* * *

Our own progress advances with that of the industry as a whole. No single unit in it need feel too small to count on us for such assistance as an industrial journal can render.

The Publishers.

WIRE & WIRE PRODUCTS

A monthly publication devoted to wire drawing and wire forming

Vol. 4 **January, 1929** **No. 1**

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Editor
Frank Quinn

Associate Editors
L. D. Granger George A. Paff

Contributing Editor
M. A. Hall

R. E. Brown, Business Manager

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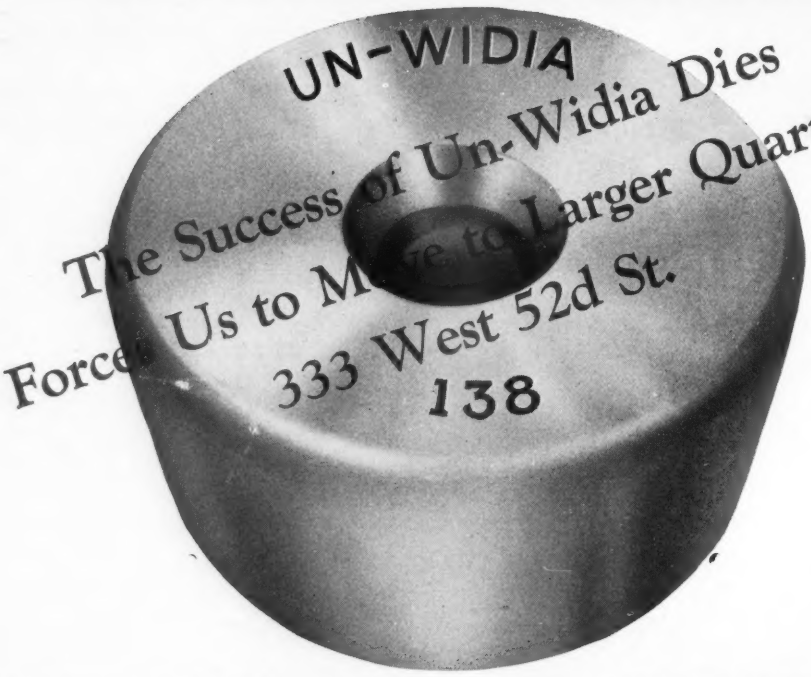
Krupp-Made Widia Metal and Wallramite Used Exclusively in These Dies



The fact remains that the European competitor is able to undersell the American Wire Manufacturer, in spite of heavy duty and transportation charges.

What Made It Possible?

The following will throw some light on the subject:

1. Die cost is reduced to a minimum with UN-WIDIA and WALLRAMITE dies, which have replaced the chilled iron, steel and in the case of hard wire, diamond dies.
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3. Quality of the wire is much finer at a decreased cost.
4. With better quality of wire from the coarse wire machine, the diamond dies last twice as long on size when redrawing on fine wire.
5. Labor is reduced in direct proportion to machine production.
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7. Many of the usual cleaning operations are eliminated by the use of UN-WIDIA and WALLRAMITE dies.

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Vol. 4 JANUARY, 1929 No. 1

Lubricants for Krupp Metal Dies

New conditions require new formulas to prevent sucking, packing and sticking in high speed wire drawing

By M. Simons

President, Union Wire Die Corporation

IN my last article, which appeared in the October issue, I have given a general outline of the new hard Krupp metal die, known here under the trade-name "Un-Widia," as well as experiences of European manufacturers in using these dies in drawing wire.

At present, here in the United States, after using a large number of the new dies on various kinds of wire, we find that somewhat different drawing conditions are required than when using chilled iron or steel dies. In the majority of cases, when using Un-Widia dies, the r. p. m. on the drawing block has been increased. This necessitates not only changes in the shapes of the bearing, but in the lubrication as well.

The increased speed naturally develops a greater amount of internal heat in the die itself. In order to keep this heat as low as possible, a proper shape of the bearing of the die must be developed. Even with the proper shape and the use of the prevailing lubricants, difficulties have been experienced, as follows: first, a tendency of the wire to suck; second, a complete packing in the front of the die; third, a welding or sticking of the wire to the die.

These three conditions are traceable to lubrication. Herewith is given a lubrication formula as developed by the European wire drawer, for use with dies, of this new metal on all sorts of wire. This formula has proven most successful, not only in Europe, where it was first introduced, but in this country where it has met with the same success.

3 gallons water to be boiled for ½ hour with
1½ lbs. of rye flour.
½ lb. of soft soap.
½ lb. of beef tallow.

After mixture is cooled, ⅓ of a lb. of sulphuric acid must be added. The proportion of soap and acid must be varied, in accordance to hardness and kind of material in work. For Copper, Brass, and Phosphor Bronze, use same mixture, but *without acid*. For Chrome Nickel and Nickel Steel, soft soap and water is to be used. Oil and grease must absolutely be avoided. Wire must be lightly chalked after treatment, but any excess of chalk must be carefully removed. If necessary with special wiper.

With the above formula, where a sucking of the wire has still been experienced, the following mixture, when added to the lubricant, immediately corrected this condition, producing wire exactly round and on size. One glassful of this mixture, added to the average quantity of lubricant used per machine, will be found sufficient.

Mix ¼ lb. of Copper Vitriol.
¼ lb. of Zinc Chloride.
2½ pints of Water.

The above, when added to the lubricant, has proved itself very efficient as a solvent for cleaning the front of the die and thereby preventing packing. When there appears a welding or sticking of wire to the bearing of the die, it is necessary to have the die cleaned first, by taking the die from the machine and removing all metal adhering to the bearing. After the die has been replaced in the machine, the presence of this mixture in the lubricant will prevent further welding or sticking.

Shape also plays an important part in the drawing of wire. Various machines with various drafts require different shapes, a subject that will be discussed at a later date.

Ball Impression Tests for Torsion Numbers and Tensile Strength

Experiments on steel wire show a constant relation between the drawing limit and degree of hardness

By Dr. Bernward Garre

From "Centralblatt der Hutten und Walzwerke", Berlin (Translated by Paul H. Wueller)

THE relative ease and facility with which the Ball Impression Test can be applied has already secured for it wide-spread recognition. Generally speaking, one determines the hardness of a given metal by pressing an annealed steel ball of 10mm dia. under a certain pressure into the even surface of the metal under consideration.

In the case of many metals, we are in a position to deduce with sufficient accuracy the tensile strength from the degree of hardness. The relation between the degree of hardness and the tensile strength of even surfaces has been determined purely experimentally. A relation between drawing limit and degree of hardness is theoretically much more probable than a relation between degree of hardness and tensile strength.

Aim of Tests

A steel ball pressed into an even surface leaves a circular imprint in that surface. However, if one presses a steel ball (under less pressure than in the previous case) into a cylindrical surface, the rim of the impression will be elliptical.

The following experiments were made in order to ascertain whether or not the elliptical impression of a steel ball (10mm in dia.), which occurs if the ball is pressed into iron or steel wire of varying diameter, may be utilized in determining the torsion numbers and the tensile strength of that wire. We furthermore endeavored to specify the limits within which our experimental results were valid, and we also evaluated their accuracy.

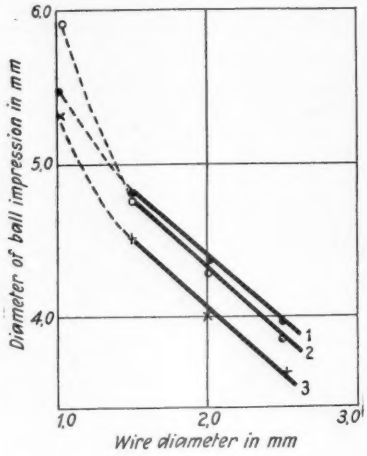

Fig. 1
1. Brake Wire Rope
2. Hoisting Rope
3. Wire Rope

The largest diameter of the elliptical ball impression, presented as a function of the wire diameter, renders the curve reproduced in Fig. 1. An approximately straight line may be drawn through the values representative of wire diameters from 1.5 mm to 2.5mm.

Fig. 2 shows that another straight line may be drawn through the values representing wire under pressure (expressed in kg.) up to the fracture point, another straight line may be drawn through the points representative of the torsion numbers up to the fracture point. The values are in each case calculated as functions of the wire diameter. Hence, it follows that a third straight line may be drawn through the values representing the tensile strength (expressed in kg.) and the torsion numbers (see Figs. 3 to 5) of the wires of from 1.5mm to 2.5mm dia.

The mathematical expression for the straight lines giving the values for brake wire rope is as follows:

$Z = -569\,E + 2950$

(Z stands for: tensile strength in kg.; E stands for: larger diameter of the elliptical ball impression)

$T = 19.7E - 53$

(T stands for: torsion-numbers up to the fracture point)

TABLE NO. 1
Impression of 10 mm Diameter Steel Ball Under 1000 kg. Pressure

Wire Diameter in mm	Largest Dia. of Ball Impress. in mm	Tensile Strength (Observed) in kg.	Tensile Strength (Calculated)	Average Deviation	Tensile Strength kg/mm²	Torsion Observed	Numbers Calculated	Deviation Per Cent
Brake Rope Wire								
1.0	5.48					98		
1.5	4.80	211	220	4.3	119	40	41.0	2.5
2.0	4.36	502	470	13.5	160	35	32.9	6.0
2.5	3.97	702	690	1.7	143	25	25.2	0.8
Hoisting Wire								
1.0	5.92					75	81.3	8.4
1.5	4.76	276	260	5.8	156	64	57.4	10.3
2.0	4.29	523	535	2.3	166			
2.5	3.86	781	776	0.6	159	38	38.8	2.2
Wire Rope								
1.0	5.36					85	77.5	8.8
1.5	4.51	301	300	0.3	170	51	52.3	2.0
2.0	4.07	552	575	4.2	175	41	39.0	4.9
2.5	3.64	853	855	0.2	174	25	26.0	4.0

The mathematical expression for hoisting-wire is:

$$Z = -540\,E + 2850$$
$$T = 20.69\,E - 41$$

For wire-rope, the mathematical expression is:

$$Z = -625\,E + 3130$$
$$T = 30.0\,E - 83$$

Average Deviation

The tensile strength and the torsion numbers can be calculated without difficulty after the larger diameter of the ball impression has been measured. The average deviations between calculated and experimentally found values are as follows:

Brake Wire Rope 6.5%
Hoisting Rope 2.9%
Wire Rope 1.5%

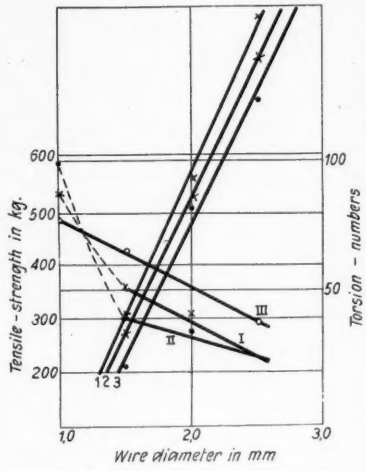

Fig. 2
1. Tensile Strength of Wire Rope
2. Tensile Strength of Hoisting Wire
3. Tensile Strength of Brake Rope Wire

I. Torsion Numbers of Rope Wire
II. Torsion Numbers of Hoisting Wire
III. Torsion Numbers of Brake Rope Wire

The ball impressions in different parts of the wire, however, are not equally large. The largest diameter of the ball impressions deviates about 5% from the average value. Already very small differences in the condition of the wire enter strikingly into appearance.

If one plots the tensile strength (calculated in kg. or kg./mm²) as a function of the ball impression for wire samples of the same diameter but of different material, one does not always obtain a straight line.

Table No. 2
Crucible Spring Steel: Impression of 10 mm Diameter Steel Ball Under 15 kg. Pressure

Wire Diameter in mm	Largest Diameter of Ball Impression in mm.	Tensile Strength (Observed) in kg.	Tensile Strength (Calculated)	Average Deviation	Tensile Strength kg /mm²	Torsion Observed	Numbers Calculated	Deviation Per Cent
1.0	4.79					58		
1.5	4.65	501			287	33		
2.0	4.45	730			232	25	25.0	0.0
2.5	4.19	1027	1042	3.6	209	22	22.2	1.6
3.0	3.75	1437	1580	3.0	203	17	18.1	6.5
3.5	3.32	1950	1992	2.0	202	13	13.7	5.3

The average deviation between the calculated and the experimentally found values are with respect to torsion numbers as follows:

Brake Wire Rope 3.1%
Hoisting Rope 6.9%
Wire Rope 5.1%

Averaging Torsion Numbers

The torsion numbers may easily be calculated by using the formula:

$$T = 10.14\,E - 20$$

In this case, the average deviation between the calculated and the experimentally found values is 3.3%.

The tensile strength (expressed in kg./mm²) of scoured wire, as a function of the steel ball impression, is represented by a straight line; its mathematical expression is:

$$Z = -125.4\,E + 510$$

The values for the torsion numbers up to the fracture point sometimes deviate 50%. Hence many experiments have to be performed in order to arrive at an average.

For wire sample of diameters from 1.5 to 3.5 mm, the tensile strength may be calculated from the larger diameter of the ball impression by using the following formula:

$$Z = -1091\,E + 5620$$

Here, the average deviation between the calculated and the experimentally found values is 2.9%.

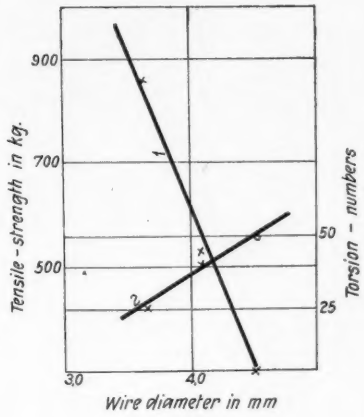

Fig. 3
Brake Rope Wire No. 1a. Diameters from 1.5 to 2.5 mm.
1. Tensile Strength
2. Torsion Numbers

The average deviation between the calculated and the experimentally found values is: 1.9%.

The values for the two other

Table No. 3
Impression of 10 mm Diameter Steel Ball Under 1500 kg Pressure

Wire Diameter in mm	Ball Impression in mm	Tensile Strength in kg. (Observed)	Tensile Strength kg /mm² Observed	Tensile Strength kg /mm² Calculated	Deviation per cent
Scoured Wire					
2.0	3.70	301	95.8	97.4	1.7
2.5	3.00	452	91.8	88.6	3.5
3.0	2.80	612	86.5	86.0	0.6
Annealed Wire					
2.0	5.10				
2.5	4.60	151	31.0		
3.0	4.50	258	36.5		
4.0	4.30	502	39.9		
Zinced Wire					
2.5	4.45	176	35.7		
3.0	4.30	321	45.6		
4.0	3.50	652	51.9		

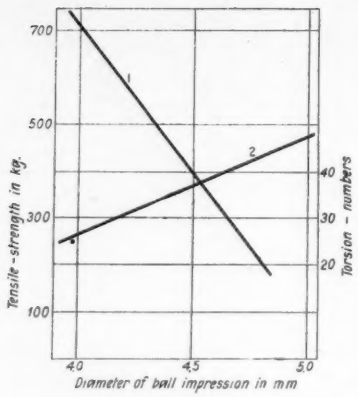

Fig. 4
Brake Rope Wire Ia., Diameters from 1.5 to 2.5 mm.
1. Tensile Strength
2. Torsion Numbers

tested wire samples exhibited such marked fluctations that the curve connecting them deviates substantially from a straight line.

The tensile-strength of hardness No. 3 may be approximated by using the formula:

$$Z = 572\ E - 1570$$

However, in this case it should be noted that the average deviation between computed and experimentally found values runs up to 17.8%. The number of torsions up to the fracture point may be calculated by using the following formula:

$$T = 565\ E - 15.1$$

The average deviation thus calculated from the experimentally found values is 12.9%.

The values for the wires of hardness No. 5 are so irregular that they are hardly accessible to accurate calculation.

If one presses a steel ball under light pressure into iron wire, one produces an elliptical impression. The wire as such, however, retains its original form. Increased pressure forces the wire substance outwardly, flattens the wire, and causes the ends of the wire to bend upward. A further increase of the pressure applied to the ball results in further flattening of the wire.

The Effects of Pressure

Under 250 kg. pressure, brake-rope-wire, hoisting-wire, and wire-rope of from 1mm to 2 mm diameter show a slight curve (see Fig. 6). The widening of the wire at the point of impression runs from 0% to 10%. Under 500 kg. pressure,

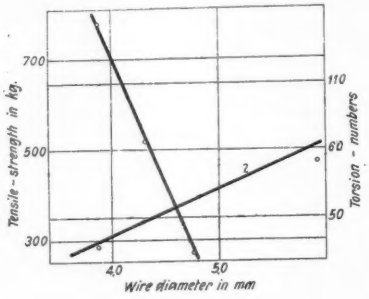

Fig. 5
Hoisting Wire of from 1.8 to 2.5 mm.
1. Tensile Strength
2. Torsion Numbers

the ball impression, as a function of the wire diameter is again represented by a straight line (see Fig. 6). Under 1000

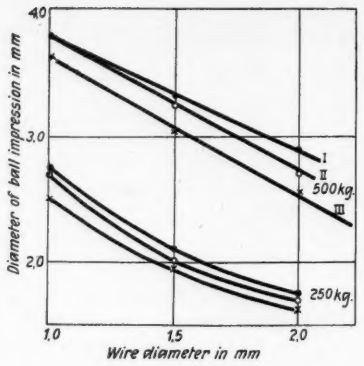

Fig. 6
1 and I, Brake Rope Wire
2 and II, Hoisting Wire
3 and III, Wire Rope

kg. pressure the values of wire of from 1.5 mm to 2.5 mm diameter can also be represented by a straight line. The ball impression upon wire of 1mm diameter is too large.

Effects of Widening the Impression

The experiments show that a widening of the wire running from 5% to 30% at the point of impression favors a straight line presentation of the torsion numbers and the tensile strength as functions of the larger diameter of the impression.

Summary

The experiments show that the steel ball method renders sufficiently accurate results to replace in many cases the customary torsion number and tensile strength tests.

Table No. 4
Special Phoenix Steel
Impression of 10 mm Diameter Steel Ball Under 500 kg. Pressure

Wire Diameter in mm	Impression in mm	Tensile Strength in kg. Observed	Tensile Strength in kg. Calculated	Deviation Per Cent	Tensile Strength kg/mm²	Torsion Numbers Observed	Torsion Numbers Calculated	Deviation Per Cent
Hardness No. 3								
0.77	3.84				145	114		
0.92	4.38	1506			100	87	96	10.3
1.10	4.42	1000	933	6.7	95	102	99	3.9
1.40	3.90	734	660	10.1	113	(50)	(79)	(58.0)
1.75	3.65	405	507	25.2	95	50	55	10.0
2.15	3.32	243	327	34.5	90	48	37	22.9
2.70	3.02	178	156	12.3	102	24	20	16.7
Hardness No. 5								
0.80	3.90	2835			143	70		
0.85	3.85	2518			143	82		
0.90	3.80	2201			140	85		
0.95	3.75	1972			140	70		
1.10	3.80	137			130	61		
1.80	3.00	550			140	35		
2.20	2.70	342			130	25		
2.80	2.45	206			127	3		

Notes On Valve-Spring Design

Why not design valve springs with frequencies so high that they will not vibrate until they have reached forced camshaft speeds?

By W. T. Donkin

*Cleveland Wire Spring Company**

ABNORMAL compression and opening of coils cause the existence of a stress and stress range much greater than those calculated by conventional formulas. Furthermore, the stress range is passed through in a time equivalent to that required for the completion of one wave of the natural period of the spring. The combination tends to accelerate fatigue and is a prolific cause of valve spring failure.

WHEN automotive valve-springs fail after comparatively short service it is common practice to investigate the failure as being due to one or more of three causes: (a) defective wire, (b) improper heat-treatment or (c) faulty design. Unfortunately, the trouble cannot always be traced back to one of these causes, hence solution of the problem is not always simple.

Investigations of failures often reveal that the wire was free from defects, that the heat-treatment was correct, and that the stress and stress range existing in the spring, as calculated from the conventional spring formulas, were of a low order.

Analysis of Failures

These failures, so difficult to classify as to cause, present several peculiar features. Life of the springs has been found in general to be somewhat proportional inversely to the camshaft speed. This proposition should be accepted with reservations, however, for reasons which will be explained later.

Another fact, which no doubt has been noted commonly, is that, from a given number of springs made from the same material under conditions seemingly identical, some fail after a very short life, whereas others give good service for a long period.

This phenomenal type of failure after comparatively short service nearly always occurs as a fracture in the region of 1 to 1½ coils from the end of the spring. Microscopic examinations of these fractures disclose them to be fatigue failures. The fracture usually makes an angle of 30 deg. with the axis of the wire and, as a rule, numerous secondary or "incipient" fatigue cracks, making the same angle with the axis, appear in the vicinity of the fracture.

It may be contended that these fatigue failures are due to the fact that stress of a higher order than that calculated through the use of static formulas existed in the neighborhood of the fractures. If such a contention is permitted, this stress concentration is definitely linked with the rate of forced vibration of the spring, the natural frequency of the spring, and such factors as the action of inertia forces due to cam acceleration and the weight of reciprocating valve-gear parts. In the following notes the parts that these variables may play in causing this stress concentration are discussed in some detail.

Laws of Spring Design

Valve-springs, like other springs, obey certain laws and can be designed accordingly. The first item to be considered is the rate of the spring in pounds per inch, in order to find the loads with the valve closed and open. The load in pounds per inch of deflection can be obtained from the formula.

$$Rr = Gd^4/8D^3N$$

where

Rr = rate, in pounds per inch of deflection
G = torsional modulus of elasticity, 12,000,000 lb. per sq. in.
D = mean diameter of spring, in inches
N = number of active coils

After determining the rate, it would be well to check up the stress by the formula

$$S = 8\,PD/Pi.1416d^3$$

where

S = stress, in pounds per inch
P = load, in pounds
D = mean diameter of spring, in inches
d = wire diameter, in inches

Experience has set a value of about 60,000 lb. per sq. in. for the maximum stress and 25,000 lb. per sq. in. as the maximum stress-range. There is a tendency today to treat the stress-range as being unimportant, yet tests and experience tend to show that stress-range is really more important than the maximum stress, up to the elastic limit. Diagnosis of the reason for this shows that, with a high stress-range, the material is put through a large angle of twist which tends to fatigue it quickly and open up any discontinuity in the metal, causing early failure. Therefore, high maximum-stress with a low stress-range is much less destructive, as the material is worked only slightly with each successive compression.

Materials and Heat-Treatments Compared

Material and heat-treatment also must be considered in valve-spring design. It used to be

*An abstract from two papers presented at meetings of the Society of Automotive Engineers by Mr. Donkin and Mr. H. H. Clark and reprinted from the Society's Journal.

common practice to make valve-springs from oil-tempered spring-wire. With the development of alloy steel the call arose for alloy-steel springs. The spring manufacturer naturally used the same continuous heat-treating process he had used on carbon-steel springs. The expected results were not obtained with the new steel and the old type of heat-treatment. Tests during a 5-year period show that springs made from soft wire, heat-treated after coiling, are far superior to springs coiled from heat-treated wire. Averages of life-tests of springs give the following as the comparative values of springs of different types:

(1) Carbon steel, heat-treated before winding 1.0

(2) Electric-furnace chromium-vanadium steel, heat-treated before winding 0.9

(3) Carbon steel, heat-treated after winding 5.0

(4) Electric-furnace Chromium-vanadium steel, heat-treated after winding 10.0

Heat Treatment Recommended

To those who are looking for the best, we therefore recommend an electric-furnace chromium-vanadium steel that is heat-treated after winding. Where price is a consideration, we believe that the results secured from a carbon steel that is heat-treated after coiling more than offset the slight increase in price due to the method of treatment.

Even though extreme care is taken with the material, heat-treatment and design, failure may sometimes be encountered after comparatively short service. Failures of this sort have been traced to the resonance between the natural frequency of the spring and the frequency of the forced vibration from the camshaft.

Any force tends to set up a wave motion in the spring, the wave length of which depends upon the natural frequency of the spring. When the forced vibration is of such a frequency that its wave length is a simple multiple of the free wave-length of the spring, a condition of resonance may be created. If the wave length is long and is such that an integral number of the free wave-lengths of the spring are completed during one cycle of the valve, the applications of the force will be in phase, and the resulting wave-motion in the spring will be cumulative and resonant.

Table 1—Characteristics of an Original Spring that Vibrated Noisily and a Redesigned Spring in which the Trouble was Eliminated

Item	Original Spring	Redesigned Spring
Mean or Pitch Diameter, in.	1.102	0.878
Free Length, in.	3 1/32	2 23/32
Total Number of Coils	10 1/2	9
Gage of Wire, Washburn & Moen No.	9	10 1/2
Load, with Valve Open at 2 1/32 In., lb.	48	53
Load with Valve Closed at 2 11/32 In., lb.	29	29
Stress with Valve Open lb. per sq. in.	41,200	57,000
Stress with Valve Closed, lb. per sq. in.	25,300	31,200
Stress Range, lb. per sq. in.	15,900	25,800
Rate, lb. per in.	59.0	77.3
Weight of Active Mass, lb.	0.1435	0.0700
Frequency or Free Vibrations per Minute	10,750	17,600

Ricardo has offered a convenient formula for calculating the natural frequency of a spring. Ricardo's formula is

$$N = 531\ V\ (R/W)$$

where

N = complete number of free vibrations per minute of the spring

R = rate of spring, in pounds per inch

W = weight of the active mass of the spring, in pounds

The derivation of Ricardo's formula is simple and can be obtained from a consideration of a spring vibrating with its ends fixed. In this case, each half of the spring may be regarded as working independently of the other half. Then, as one half works as an extension spring, the other half works as a compression spring, and vice versa.

Natural Frequency Formulas

If the central coil of the spring is assumed to move through a distance of a inches, the maximum displacement will be a distance $a/2$ to either side of the rest position. Each half of the spring or a compression spring, moving a distance of $a/2$. Since the amplitude is half the displacement, the amplitude for the half-spring will be $a/4$. The inertia force will then be:

$$Fi = (W/2g)\ (a/48)\ w^2$$

where

$a/4$ = amplitude, in inches

Fi = inertia force

g = force of gravity

w = angular velocity of periodic force, or radians divided by seconds

$W/2$ = weight of half the spring, in pounds

Since the rate of the spring in number of pounds required to compress it 1 in. varies inversely with the number of coils, the rate of the half-spring will be $2R$ and the resisting force due to the stiffness of the spring will be:

$$Fr = 2R\ (a/2) = Ra$$

where

$a/2$ = deflection of the half-spring, in inches

Fr = resisting force

R = rate of the spring, in pounds per inch

These two forces will be equal and opposing, and, hence, by equating the two and evaluating the constants, the formula (1) is obtained.

The natural-frequency formula must be employed with caution, as, notwithstanding design figures, two springs seldom have the same natural period, because of the slight variation in the gage of commercial wire, the slight difference in pitch-diameter, and differences between one spring and another in the number of active coils, all of which affect the rate in pounds and the weight of the active

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Wire Rope and Safety

Experience shows that most wire rope failures are due to misuse or faulty connections

By D. F. McMurchy

Structural Engineer, Industrial Commission of Ohio

WIRE rope has perhaps done more than any other item of equipment to facilitate the construction of our larger structures. It has made possible the power equipment used in excavation, erection and transmission, without which operations would be seriously hampered. Its ability to withstand abuse, combined strength and flexibility, recommend wire rope for the severe service required on construction work.

It has been my experience that the majority of wire rope failures have been due to improper care, use and connections rather than to defects in the wire rope.

Wire Rope Limitations

If we consider the construction of wire rope we immediately sense its limitations. The construction most familiar on building operations is 6x19, that is, 6 strands of 19 wires each twisted around a hemp center to form a rope. Three grades of wire are most commonly used in its manufacture — iron, crucible steel and plow steel. The latter two, because of their combined strength and flexibility, are generally used on construction operations, such as rigging for hoisting, transmission and excavating equipment.

Frequently cables that have been removed from this equipment are again placed in service as guys on towers and derricks and as lashing, slings, etc. Other constructions are manufactured to serve various purposes requiring greater strength or flexibility, but the 6x19 construction more nearly satisfies the contractor's requirements. Being made of wire it is not as flexible as hemp rope and cannot be bent sharply without seriously affecting its strength.

The "Contractor's standby", a good fastening for general use. The half-hitch kinks the line and reduces its strength about 50 per cent, but safety does not depend so much on the tightness of the clamp.

The contractor in ordering rope has to rely almost entirely upon the integrity of the supply dealer in the matter of getting the rope specified. Few workmen can tell by the appearance or feel of a rope whether it is iron, crucible or plow steel. They look alike, but their strengths vary considerably, iron rope having about 40 percent and crucible cast steel about 85 percent of the strength of a plow steel rope of the same diameter. Iron rope when bent with the hands does not have the tendency to spring back that crucible or plow steel ropes have, and may be detected in this manner, but the difference in spring between the crucible and plow is hardly perceptible.

To overcome this uncertainty the method of weaving into the hemp core a narrow tape indicating the material, strength and the name of the manufacturer is decidedly helpful.

Three Vital Points

Three major factors govern the life and strength of wire rope, external wear, internal wear and kinking. A new rope being circular in section, presents only the surface of one or two wires of each strand at any section to external wear against the sheaves and other objects with which it comes in contact. Abrasion against the sheaves, augmented by gritty substances contained in the dust and mud ever present around construction operations, tend to wear these outside wires very quickly, reducing their sectional area.

As the process continues the next adjacent wires begin to wear, but rarely more than three wires of any strand present a wearing surface to the sheave before one wire breaks. This failure increases the load on the other wires and with their decreased sectional area they fail rapidly.

When to Replace Rope

As a means of reducing external wear on rope it is essential that the sheaves be properly aligned and that the grooves of the sheaves be kept in good condition. Sheaves with broken flanges or that have oversize bores, not only increase the wear on the cable, but also the hazard of the line jumping the sheave, which often produces disastrous results. Running lines should be clear and well lubricated and should not be allowed to wear against any material which will tend to abrade them.

The question of the use of hard or soft sheaves depends upon existing conditions. In some instances it is more economical to replace the sheave than the line; in others the opposite is true. A rope should be replaced, according to the Bureau of Mines, when the diameter of the outside wires has been worn to 65 per cent of their original diameter, or if six broken wires appear in one twist or lay of 6x19 rope. It is recommended that rope be dis-

Presented at the Seventh Annual Safety Congress, Construction Section.

This connection is 75 per cent efficient if the clamps are kept tight but not tight enough to crush the wires. After the load is applied clamps should be retightened and inspected regularly.

carded if five wires are broken with 10 per cent wear on outside wires, and three wires are broken with 30 per cent wear on outside wires.

Another factor affecting the life of wire rope in service is internal wear. Being flexible, there is considerable internal motion in the rope as it changes direction under load as when passing over sheaves. The outside wires of the rope passing over a sheave are stretched more than the ones adjacent to the sheave. This unequal stretching produces internal motion within the rope which unless thoroughly lubricated, tends to wear the rope from within.

Relation of Sheave Sizes

Where the rope is subjected to reverse bends, as in the case of the load line on a derrick passing from the hoist engine under a sheave at the bottom of the mast and over a sheave a short distance up the mast, this stretching shifts from one side of the rope to the other, increasing the internal motion and consequently the internal wear. It follows that the smaller the sheave, the greater the stretch in the outside wires. Wire rope manufacturers recommend sheaves of a diameter in feet equal to four times the rope diameter in inches for crucible steel or plow steel rope.

Internal wear can be materially reduced by proper lubrication and the use of larger sheaves. The latter is not always possible, being limited by the design of the equipment, but larger sheaves will pay their added cost in increased rope life where conditions permit their use. The value of lubrication cannot be stressed too strongly and the additional cost of lubricating them is negligible when compared with the increased life resulting. Proper lubrication will minimize the breaking of interior wires which weaken the rope and which cannot be detected by casual inspection.

A third major factor is kinking. To sever a wire without the services of wire cutters we kink it and it breaks easily. Kinking has the same effect upon wire rope, it being nothing more than a twisted bundle of wires. We know also by experience that the harder the steel the more brittle it becomes, having broken soft iron or copper wire in one instance and steel piano wire in the other, the latter breaking with much less kinking than the former.

Kinking is probably the most destructive of the three major causes of wire rope failure, as little warning is given of the weakened condition. Great care should be exercised in taking wire rope from the reel to avoid kinks. It is a good plan either to roll the reel along the ground or floor or to mount the reel on a bar and run the rope off as needed. When taking wire rope from a coil, roll the coil along the ground rather than pull it from the coil while it is lying flat.

Minor Causes of Failure

Wire lines are frequently snarled when a clam shell turns over or a load slips. Such occurrences very often produce kinks and sometimes snags. Snarled lines should be straightened very carefully and inspected for snags or cuts before subjecting them to loads.

There are other factors affecting the strength of wire rope, such as unlaying of strands due to lack of sizing, corrosion from various causes, fatigue and others, but the majority of failures in wire rope are traceable to the three major causes given above, providing, of course, that the proper kind and construction of rope was selected for the work in hand.

Importance of Clip Connections

At this point I would like to say a few words about connections. Of the various connections manufactured, the clip is used more frequently than any other type on construction work. Its cost, ease of application, efficiency and adaptability are responsible for its extensive use in preference to other types with greater efficiency, such as leaded sockets or wedge socket connections.

Clip connections can develop efficiencies of better than 80 per cent when properly applied, but connections of this strength are rarely found. Many riggers prefer to stagger clips on clip and thimble connections for no other reason than that they have always made such connections in that manner. The "U" bolts when drawn too tight, as they frequently are, crush the wire line at the point of application —kinking the strands at that point. If the "U" bolts are placed on the free end of the line, the friction around the thimble reduces the load on the line at the clip, thus offsetting in a measure the decreased strength due to the crushing effect of the bolt. When applied in the opposite manner the full load is subjected to the weakened section directly under the bolt. Better connections are

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Two things are wrong in this connection. (1) The left hand clamp is wrong side up; the U-bolt should be on the short end of the rope. (2) Clamps are too tight, crushing cable as shown by right hand picture.

Observations On European Rod and Wire Drawing Practice

Copper rod, extruded brass, industrial competition and the labor situation arouse the interest of an American observer

By David Levinger

*Engineer of Manufacture, Western Electric Co.**

THESE observations of the metal-working industries of Europe are based on a three months' tour of eight countries of Europe, in which 75 industrial establishments were visited in England, France, Germany, Belgium, Holland, Italy, Austria and Switzerland during the summer of 1927.

One of the interesting experiences in England was to see, in a very old plant under the management of an old family, what seemed real evidence of at least one reason for England's unfortunate industrial situation. Poorer building and plant facilities are hard to imagine. Under the same roof is found fairly modern machinery operating alongside of what we were told was the first machinery ever built for carrying on this kind of manufacture. This old equipment of course had only a fraction of the productivity of the new and has probably outlived its economic usefulness and will not be scrapped until it falls to pieces—and that may be a very long time. I saw the same situation in this same plant ten years ago.

An Up-to-Date Rod Mill

In another plant in England we were the first outsiders to be shown the fine new copper rod mill recently designed, constructed and installed by one of Germany's largest mill builders. This British plant is laid out to produce copper rod 5/16 in. diameter by as completely automatic equipment as I believe exists in the copper industry. It has automatic electric charging equipment for feeding the wirebar heating-furnace, and live rolls to feed the heated bars to the roughing mill, which is fully equipped with automatic repeaters.

Wire bars weighing 140 lb. were rolled in this mill in 18 passes, only one bar being in the intermediate and finishing mills at one time. The output of 5/16 in. copper rod on this mill was about one bar per minute. This production may be compared with the new Western Electric Company's mill built in 1924 in which ¼ in. round rod is rolled in 14 passes from 220-lb. wire bars in the intermediate and finishing mills at one time, giving production in the neighborhood of 165 bars per hour.

Wire Bars Poured by Hand

While in England we took occasion to observe some of the practices of tool steel manufacturers in the Sheffield district. The industry is still surrounded by some of the halo of tradition and at least in the plant of one of the best-known steel makers we found little to indicate adoption of modern practices. Crucible fires were used entirely and we were shown with great pride the genuine old Sheffield furnace battery of 150 years ago. Here the high carbon metal was prepared for the melt by the cementing process where carbon-free Swedish iron bars piled in layers in charcoal are carbonized in a glowing furnace for 40 or 50 hours.

One of the strange experiences was to find an unusual process in one of the most out of the way places on our tour, in a very small brass and copper plant in a small wayside village in England. In this plant it is the practice to pour all copper from the refining furnace by hand and wire bars are poured in vertical molds. Sounder bars and lower scrap losses were claimed to be the advantage. Another interesting feature of their practice here is to carry the hot wire bar on a conveyor directly to the hot rolling mill when casting and rolling were going on at one time thus avoiding reheating for the rolling operation. When the bars were coming to the mill faster than the mill could roll them, they were placed in a furnace and thus some heat conservation was realized in this way.

Continental practices in copper rod and wire manufacture are not unique and resemble very much the older practices employed in this country, with one exception. The Europeans have developed the use of repeaters in the rod mills more than we have and I believe that practically every rod mill in Continental Europe is equipped with them.

New Extruded Brass Process

We found a new development in the brass extrusion field commanding the interest of manufacturers of extruded rod throughout Europe. This is the so-called inverted press, first tried in England. In this machine the process of extruding the brass billet through the die is reversed, the billet being held in a fixed position and the die carried by the ram is forced against the billet. Savings in power up to 30 per cent were testified to by some users, with higher quality bars and lower

(*Please turn to page 30*)

*From a paper on European Factory Methods and equipment in Mining & Metallurgy.

NEWS *of the* INDUSTRY

Foreign Trade Opportunities

FOREIGN trade opportunities reported by the U. S. Bureau of Foreign and Domestic Commerce during the month of December include inquiries from the following sources: For enameled copper wire (34830) from Kobe, Japan; for wire fencing and gates (34842) for stock and chicken yards, from Halifax, Nova Scotia; for instruments, measuring and precision, and laboratory equipment (34878) from Prague, Czechoslovakia; for mattress fittings, horizontal spring (34831) from Glasgow, Scotland; for cables and switches (34938) from Johannesburg, South Africa; for bolts and nuts (35000) from Sheffield, England; for conveying equipment (35029) from Berlin, Germany; for lifting devices (35022) from Dusseldorf, Germany; for hard drawn bare copper wire (35100) from Johannesburg, South Africa; for barbed wire and galvanized wire netting (35142) from Patras, Greece; for galvanized nails and staples (35228) from Managua, Nicaragua; for wire and seal machinery for bottles (35253) from Montivideo, Uruguay.

Czechs Buy Machinery

CZECHOSLOVAKIA offers a large potential market for modern machinery of United States manufacture, the Department of Commerce stated November 14.

Czechoslovak manufacturers are continuing to modernize their plants and are introducing standardization in order to meet the strong competition. The most modern machinery is, therefore, imported and special machinery, not as yet manufactured locally, is still in great demand. Unfortunately the bill for extending the period of the law granting a reduction up to about 80 per cent of the duty on industrial machinery imported, when its use could be shown to increase either when the same equipment could not be purchased locally, is still pending.

The old law expired on June 30, 1928, but the bill introduced last March asks for an extension of the period to December 31, 1929. The passage of this bill would also favor American special machinery imported into Czechoslovakia.

As compared with the figures for 1927, American machinery imports into Czechoslovakia nearly doubled during the first eight months of 1928, which is a sign that the Czechoslovakian market for American machinery, especially automatic and special purpose machinery, may still be more developed.

Swedish Packing Methods

METHODS of packing wire cloth exported from Sweden is the subject of a report to the Department of Commerce from Assistant Trade Commissioner Emil Kekich at Stockholm. Wire cloth exported from Sweden usually varies in width from 2½ to 6 meters, and in length from 15 to 25 meters; it is rolled on wooden cylinders, which are then packed in wooden boxes. Usually only one metal cloth is shipped in each box. These boxes vary in size from 3 to 6 meters in length and from 20 to 50 centimeters in width and height. Boxes are not nailed together, but are provided with three metal clasps, which are screwed together in such a way as to keep the box locked. This arrangement is done so that the customs authorities will not have any difficulty in opening the box, instead of pulling out nails and renailing the box, wherein the cloth is liable to damage. The weight of these boxes ranges from 100 to 150 kilos.

Civil Service Vacancies

The United States Civil Service Commission announces the following open competitive examinations: Physical Chemist (qualified in ferrous metallurgy), $3,800 a year: Associate Physical Chemist (qualified in ferrous metallurgy), $3,200 a year.

Applications must be on file with the Civil Service Commission at Washington, D. C., not later than January 16. The examinations are to fill vacancies in the Bureau of Mines, Department of Commerce, for duty in Washington, D. C., or in the field.

The Commission also announces an open competitive examination for Senior Physical Metallurgist.

Applications must be on file with the Civil Service Commission at Washington, D. C., not later than January 23. The examination is to fill a vacancy in the Bureau of Standards, Department of Commerce, Washington, D. C., and vacancies occurring in positions requiring similar qualifications. The entrance salary is $4,600 a year. Higher-salaried positions are filled through promotion. The duties are to conduct research or investigative work in physical metallurgy in connection with the control of the properties of metals and their alloys and the methods of testing such properties. This investigative work will involve a study of problems such as the following; Metallurgy of magnet steels, the properties of pure iron-phosphorous alloys, liquid shrinkage of alloys, and X-ray crystal structure of alloys.

Competitors will not be required to report for examination at any place, but will be rated on their education, training, and experience, and writings to be filed by the applicant. Full information may be obtained from the United States Civil Service Commission, Washington, D. C., or from the secretary of the United States Civil Service Board of Examiners at the post office or custom house in any city.

Acme Wire Improves

President Thomas G. Nee, Acme Wire Company, New Haven, Conn., in a statement issued December 5th reports general improvement in the Company's business for the past six months. Some departments have been working at full capacity for 24 hours a day and others have been working overtime. Lack of trained operators handicapped production, necessitating refusal of many orders for coils and fine wire, but these departments are now working to full capacity, products are being sold at fair prices, and net profits have been satisfactory. A preliminary report of results of operations for 1928 is promised to stockholders for January 1st.

Building and Expansion

Hunter Pressed Steel Co., Lansdale, Penna., is completing the erection of an important addition to its plant that will double its production of coil wire springs and provide capacity for greater tonnage and variety of wire sizes.

National Umbrella Frame Co., Philadelphia, will build and equip a new factory addition at an estimated cost of $50,000.

Reynolds Spring Co., Jackson, Michigan, has purchased and will remove to its Jackson plant the business of the National Appliance Co. of Linden, Michigan, manufacturers of industrial lighting equipment.

COMING EVENTS

Jan. 5-12. National Auto Show, Grand Central Palace, New York.

Jan. 14-18. American Society for Steel Treating, Semi-Annual Meeting, Los Angeles, California.

Jan. 14-18. National Metal Congress, Los Angeles, California.

Jan. 15-18. Society of Automotive Engineers. Annual Meeting, Book-Cadillac Hotel, Detroit, Michigan. Coker F. Clarkson, Secretary, 29 W. 39th St., N. Y. C.

Feb. 12-15. Chicago Power Show and Midwestern Engineering Exposition at Chicago. Secretary, G. E. Pfisterer, 53 W. Jackson Blvd., Chicago.

Mch. 13-14. Annual general meeting of the Institute of Metals. Hall of the Institution of Mechanical Engineers, Storey's Gate, S. W. 1, London, England.

May 6-11. Chemical Show. Grand Central Palace, New York City. International Exposition Company; F. W. Payne, President.

Bradford Armature Works, 315 East Broadway, East St. Louis, Illinois, is planning the erection and equipment of factory addition at an estimated cost of $26,000.

A new Portland, Oregon, branch warehouse will be built by Broderick & Bascom Wire Rope Co., St. Louis, to take care of northern Pacific Coast business.

Cuyahoga Steel & Wire Co., Cleveland, Ohio, announces the appointment of L. B. Godfrey as Eastern Sales Manager with offices at 70 North Beacon Street, Hartford, Conn.

Wallace Barnes Co., Bristol, Conn., manufacturers of spring, etc., is planning additional manufacturing plants in Bristol and Forestville as part of an expansion program estimated to involve an expenditure of about $400,000.

W. S. Tyler Co., Cleveland, Ohio, manufacturers of woven wire products, screens, sieves, etc., is planning the erection of a Canadian plant at St. Catherine's, Ontario.

A & B Spring Co., Oklahoma City, Okla., is planning to build and equip a new factory unit at an estimated cost of $50,000.

Wickwire Spencer Steel Co., New York, will build a warehouse for branch distribution at Portland, Oregon, to take care of business formerly done through dealers.

Crescent Insulated Wire & Cable Co., Trenton, N. J., has awarded contract for a new $60,000 factory addition to its present plant in East Trenton.

American Steel & Wire Company has obtained permit for the erection of a factory building at Allentown, Pa., at an estimated cost of $32,000.

Brown Fence & Wire Co., Cleveland, Ohio, is launching a $6,000,000 stock issue for expansion purposes which will also affect its subsidiary, the Peerless Wire & Fence Co., Adrian, Michigan.

The Manitoba Bridge and Iron Works Ltd., Logan Ave., Winnipeg, Man., have been awarded a contract by the Canadian National Railways, headquarters, McGill St., Montreal, Que., for the construction of an iron bridge to cost approximately $300,000.

Anaconda Gets Cable Order

Anaconda Copper Mining Co. has received from the Societ Meridionale di Electricitta of Naples, Italy, an order for an all copper hollow conductor cable weighing 1,850,000 lbs. This is the first order ever secured by an American manufacturer for an all copper cable of this kind to be shipped to Europe. The cable will be used to transmit power from Pescara to Naples, a distance of 118 miles.

The Pescara-Naples system is to be of 3-phase operation at 154 kilovolts. The hollow construction of the cable is a development of Anaconda engineers to insure efficiency in transmitting large voltages.

Sleeper & Hartley TRADE MARK

Practical Continuous Wire

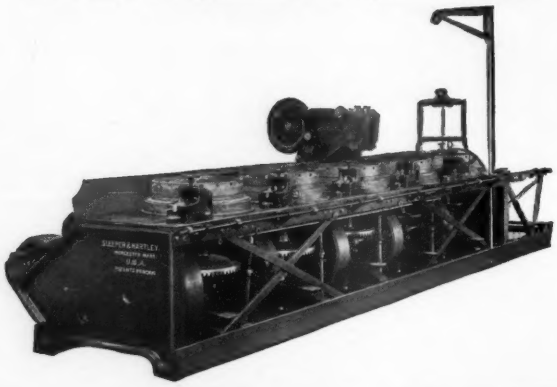
These Machines Go Into Production at once—

Rod Frame

(No. 5—14 or 15 wire)

Patented June 3, 1924—May 12, 1925—others pending

All Ball or Roller Bearings
No Differential Gearing.
Automatic Compensation for Speeds of Heads.



Double 5-Drafty,

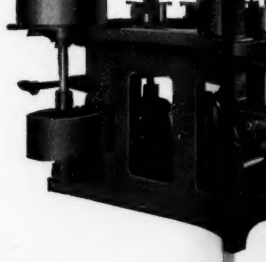
No. 14 to No. 23. ft or

3 to 4 Blocks verag

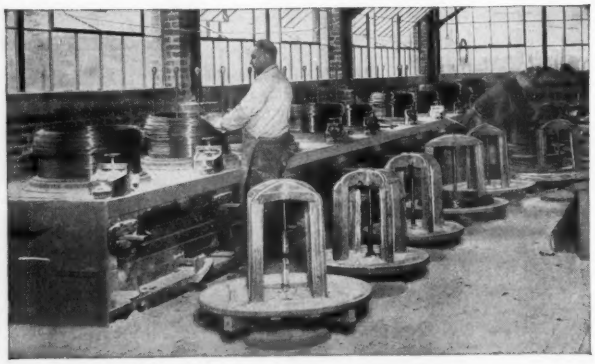
No. 14 to 19—4 1400

No. 14 to 20—5 1100

More than 270 heads of improv



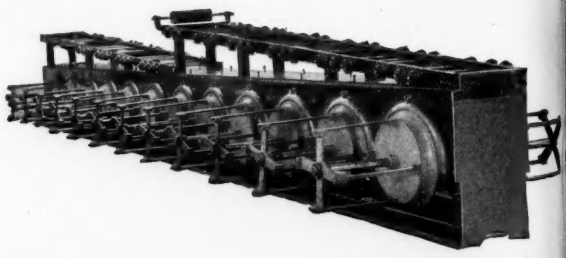
IMPROVED WIRE MILL EQUIP



Standard Rod Frame—10 Block

Long, Stiff Spindles, in anti-friction bearings, and equipped with friction Clutches. Powerful and reliable.
Practically noiseless in operation.

(New Plant of Thompson Wire Co., Worcester, Mass.)



Patenting Furnace Take-Up

(New Plant of Thompson Wire Co., Worcester, Mass.)

AGENTS: CHICAGO TERRITORY, Neff, Kohlbusch & Bissell, Inc. SAN FRANCISCO AND LOS ANGELES Louis G. Henes

SLEEPER & A

FOREIGN AGENTS AND REPRESENTATIVES: UNITED KINGDOM—Mr. Fredk. A. Perry, 63 Queen Victoria St., London, E. C. 4. FRANCE—Mr. Edgar Bloxham, 12 Rue du Delta, Paris. BELGIUM—Isbecque, Todd & Cie., 25-27 Boul. Emile Bockstael, Brussels. MONTREAL AND TORONTO—Arthur Jackson Machine Tool Co.

WORCESTER, MA

Wire Drawing Machinery

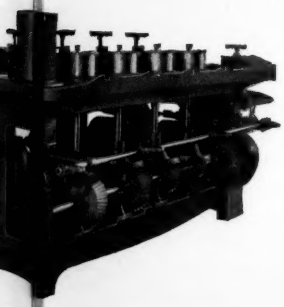
Sleeper & Hartley TRADE MARK

REG. U.S. PAT. OFF. & PRINCIPAL FOREIGN COUNTRIES

n at ce—Reducing Overhead-Increasing Production!!

raftry, Intermediate

23. h or low carbon wire.
ocks verage Operator.
—4 1400 lbs. per block.
—5 1100 lbs. per block.
ds of improved model in operation

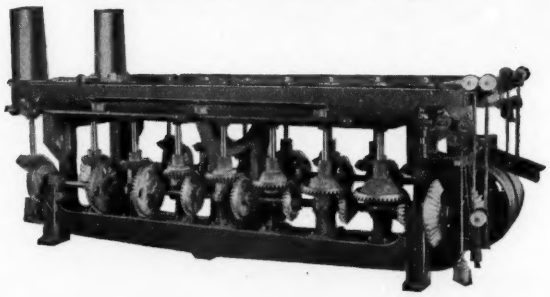


Double 8-Draft Fine Wire: Wet

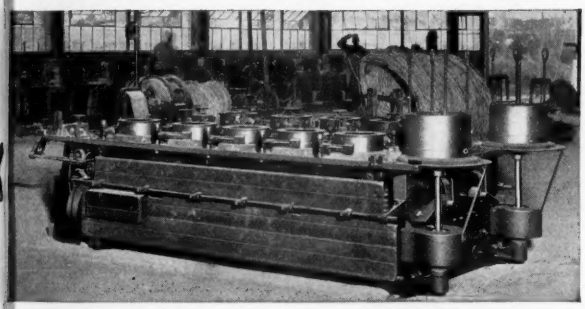
No. 22 to 36. High or low carbon wire.

6 Blocks to Average Operator, 22-33, 8-hole, 660 lbs. per day of ten hours.

Many thousands of these heads in operation



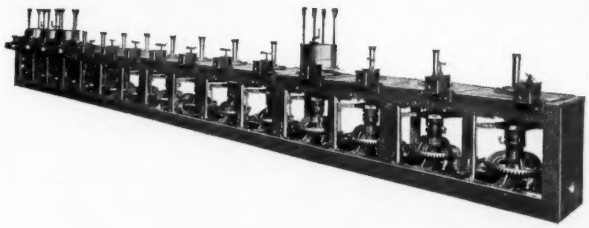
UIPMENT RECENTLY INSTALLED



Double Six—Draft Dry Continuous For High Carbon Wire

Direct driven with silent chain. Cut gears throughout. Anti-friction bearings. Variable speed for finishing block.

(New Plant of Thompson Wire Co., Worcester, Mass.)



Heavy 16″ Frame For .65 Carbon Wire No. 10½ to .037″

15 Blocks: Motor driven. Silent chain. Anti friction bearings and cut gears throughout.

(New Plant of Johnson Steel & Wire Co., Worcester, Mass.)

& HARTLEY, Inc.

Agents: Philadelphia Territory
Swind Machinery Co.

ITALY—Henry Coe & Clerici, Milan. AUSTRALIA AND NEW ZEALAND—Edwin Wood Pty., Ltd., Melbourne.
JAPAN—Andrews & George Co., Toyko. SWEDEN AND FINLAND—Maskinaktiebolaget Karlebo, Stockholm.

WORCESTER, MASS., U. S. A.

Wire and Rod Requirements In Gas Welding

Standard sizes and lengths of welding metals are now recommended for the oxy-acetylene process

DRAWN wire and rods of suitable composition for specific purposes play so important a part in gas welding and cutting that the accompanying table of recommendations for ordinary practice has been prepared by the oxy-acetylene committee of the International Acetylene Association. Our selection is from the annual report of that body, which outlines the developments in the use of gas welding in various industries and points out some of the possibilities for future extension.

It does not require a very extensive analysis of the welding industry, says the report, to show clearly that iron and steel remain the outstanding of all fabricated metals by a very large percentage, and that welding materials that apply to these metals are in the majority.

All Metals Now Welded

It is not very long ago that these were the only metals other than cast iron that could be commercially welded. A man who could weld manganese steel or aluminum was considered a past master of the art.

Today every known commercially used metal is welded by the oxy-acetylene process and there is a suitable welding metal for each.

Alloy steels, stainless steels, acid-resisting iron, corrosion-resisting bronzes, aluminum, manganese steel, Monel metal, Stellite, copper and bronze mixtures of every nature are being welded successfully.

Successful welding of any metals depends on procedure, skill, equipment, and the welding materials. This resume is, however, intended to list only the available welding materials for various metals.

For some metals, cast rods are used in combinations with or without a flux. Others require drawn wires or rods and no flux depending on the nature of the metal and the conditions surrounding the application.

Fluxes are not always used by extra-skilled welders, but where recommended by authorities, they should be used to secure uniformly satisfactory results.

Notwithstanding that carefully prepared specifications exist for welding materials, and many claims are made for particular metals, it is important in all cases that welding materials be secured only from those whose recommendations can safely be depended upon and they should always be used in the manner specified by the manufacturer. This applies to

(*Please turn to page 29*)

Metal	*Welding Metal*
Aluminum—	
Castings	Cast Aluminum Bars of same analysis, sizes 3/16, ¼, 5/16 ..... 12 to 20" lengths
Sheet	Pure Aluminum Wire of same analysis, Sizes 1/16, ⅛, ¼ coils ..... 36" lengths
Brass (Sheet and Castings)	Tobin or Manganese Bronze Rods, sizes, ⅛, 3/16, ¼ ..... 36" lengths
Bronze	Manganese Bronze Rods, sizes ⅛, 3/16, ¼ ..... 36" lengths
Copper	Tobin or Manganese Bronze Rods, sizes ⅛, 3/16, ¼ ..... 36" lengths Copper Wire, sizes ⅛, ¼ in coils.
Cast Iron	Cast Iron Bars, sizes 3/16, ¼, ⅜, ½, 12 to 24" lengths Tobin or Manganese Bronze, sizes ⅛, 3/16, ¼ ..... 36" lengths
Chrome-Nickel Steel	Chrome-Nickel Steel Rods, sizes ¼ .... 12" lengths
Duraluminum	Pure Aluminum Wire, sizes ⅛, 3/16, ¼ ..... 12" lengths
Duriron	Cast Duriron Bars, sizes ¼ ..... 12" lengths
Everdur	Everdur Cast Bars or Wire, sizes 3/16, ¼ ..... 12" lengths
Gray Iron	Same as Cast Iron.
High Carbon Steel	Special H.C. Rods or Wire, sizes 3/16, ¼ ..... 36" lengths Nickel Steel Rods, sizes ⅛, 3/16, ¼ .... 36" lengths
Iron	See Steel.
Lead	Pure Lead Wire, size ⅛, in coils.
Malleable Iron	Tobin or Manganese Bronze Rods, sizes ⅛, 3/16, ¼ ..... 36" lengths
Manganese Steel	Manganese Steel Wire, sizes ⅛, 3/16, ¼ ..... 36" lengths
Monel Metal	Monel Metal Wire, sizes ⅛, 3/16 ..... 36" lengths
Molybdenum Steel	Same as used for regular low and medium Carbon Steels.
Chrome Iron Alloys (such as Stainless Iron and Steel)	Cast Bars or Wire of same analysis, size ¼ ..... 12" lengths
Steel*	Low Carbon Steel Wire, sizes 1/16, 3/32, ⅛, 3/16, ¼, 5/16, in 36" lengths or coils, usually copper coated; Special Rods are also available for special purposes.
Stellite	Stellite Cast Bars, sizes ¼ ..... 12" lengths
Vanadium Steel	Vanadium Steel Wire, size ¼ ..... 36" lengths
Wrought Iron	Same as Low Carbon Steel.
Nickel Steels	Nickel Steel Wire, sizes ⅛, 3/16, ¼ .. 36" lengths

*Standard analysis such as tank, plate, fire box steel, structural steel, boiler plate, tubing, etc.

DIGEST OF RECENT TRADE LITERATURE

Accelerated Laboratory Corrosion Test Methods for Zinc Coated Steel. Bureau of Standards Journal of Research. August, 1928. P. 255.

In the course of a contribution to Wire & Wire Products on chemical tests of wire, Mr. J. D. Brunton, in the November issue, devoted some space to the salt and spray tests for zinc coatings. The tests reported in greater detail in the paper here reviewed include these two methods among others devised for evaluating the life of the coating on hot dip zinc coated steel and their probable wearing qualities when exposed to the corrosive effects of atmospheric changes. A consistent relationship between the life and weight of the coating was shown by the results. Although the experiments were made on specimens of sheet steel, the technique of the tests and the findings of the investigators can be applied to coated wire. The report is comprehensive and amply illustrated.

Notes on the Manufacture and Properties of Some Copper-Cadmium Alloys. Brass World & Platers' Guide. September, 1928. P. 273.

A summary of the results of experiments to determine physical properties of various alloys of copper and cadmium to produce a wire with a minimum loss of electrical conductivity. The experiments included tensile, hardness and corrosion tests. One of the conclusions reached is that wire drawn from copper containing a small amount of cadmium has a much greater tensile strength, is considerably harder, has a higher annealing temperature than a pure copper wire of the same size, and its electrical conductivity has been reduced to a lesser degree than for any other known alloy of equivalent tensile strength.

Functions of the Production Executive. Business organization Series. No. 12. Policyholders Service Bureau, Metropolitan Life Insurance Company, New York City.

An analysis of the functions of the key executives in the organization. Reports a study of a number of business houses and industrial plants, the division of responsibilities, inter-departmental relations, executive responsibilities and methods of production control. A graphic chart shows the distribution of the functions of the chief production executives in fourteen typical industrial plants.

Economic Research and Industrial Growth. Conference on Library and Research. October 23, 1928.

Doubts as to the value of iron and railway traffic as trade barometers have been growing due to wide fluctuations. It is suggested that the best barometer for present and future lies in the size of the postal receipts. Averaging over a period of years fluctuations of total trade from the line of growth would not amount to more than four or five per cent. The normal rate of growth is four per cent a year.

Trade Literature Received

Welding Processes

The Lincoln Electric Company have recently published a supplement to their 160-page text book, "Arc Welding—The New Age in Iron & Steel." This 32-page supplement is entitled "How to Begin the Application of Arc Welding in Production Manufacturing." The bulk of the text is devoted to the redesigning of machinery and the principles are set forth in detail. Line drawings show how standard steel shapes are utilized to build up structures which formerly would be cast. Along with these theoretical designs are shown photographs of similar designs in actual use.

Factory Inventory

"How to Take Inventory in Manufacturing Plants." The Barrett Bindery Co., 1328-43 W. Monroe St., Chicago. 32 pages. Pocket Size. Illustrated. Outline of a simple organized plan for taking a physical inventory. Covers planning and preparation, taking the inventory, pricing and summarizing. Illustrated with suggested forms for tags, card records, sheets and incidental stationery requirements.

Electric Wiring

"Data Sheets". Hoist & Crane Engineering Co., 114 Liberty Street, New York City. Eight standard-size punched loose-leaf binder sheets, illustrated, of data about electric wiring fixtures such as a conductor support, insulator, bar clamp, ear, insulator and take-up, support clamp, conductor joint, connector and current tap.

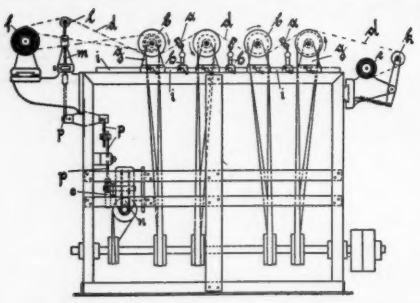
Materials Handling

"Monorail Conveying Systems." Reading Chain and Block Corporation, Reading, Pa. 60 pages. Illustrated with diagrams and photographs. Chain and electric hoists, trolleys, cranes, and equipment for overhead materials handling. Stresses standardized and interchangeable installation units.

Industrial Machinery

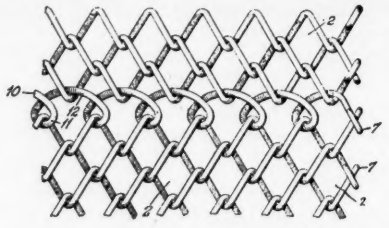
"Ideal Industrial Machinery." Ideal Industrial Machinery Division of Consolidated C. M. Corporation, Cincinnati, Ohio. 32 pages. Illustrated. Includes machinery for tumbling, pickling, cleaning, washing and drying small parts such as chain links, bolts, nuts, screws and lock washers.

A REVIEW OF RECENT PATENTS



Multiple Wire Drawing Machine 1,693,224

Complete descriptions and drawings of any of the patents referred to on this page may be had for twenty five cents. Address orders to Wire & Wire Products, 551 Fifth Avenue, New York City.



Woven Wire Fabric and Method of Making 1,691,507

No. 1,693,224, MULTIPLE WIRE DRAWING MACHINE FOR DRAWING FINE WIRES FROM SUITABLE MATERIAL. Patented November 27, 1928 by Peter Darmstadt, Wilhelm Stegmann and Valentin Weil, of Fechenheim, Near Frankfort-On-The Main, Germany, Assignors to the firm Drahtindustrie Peter Darmstadt & Co. G. M. B. H., of Frankfort-On-The-Main, Germany. A multiple wire drawing machine comprising a plurality of dies through which the wire is adapted to pass successively, and a drawing roll mechanism arranged to engage the wire on its way from each of said dies to the next, along a peripheral contact portion the angular extent of which decreases progressively between successive pairs of dies, as the cross-section of the wire is reduced.

No. 1,691,507, WOVEN WIRE FABRIC AND METHOD OF MAKING IT. Patented November 13, 1928 by John C. Anderson of Keyport, New Jersey. This invention has special reference to fabrics designed for use as conveyor belts. An object of this invention is to provide a sectional woven wire fabric having straight side edges and so constructed that when made into an endless traveling belt it will be free from any tendency to creep laterally upon the rollers or other supports which carry the belt. This object is accomplished by making the belt in sections composed alternately of right-hand coils and left-hand coils, and by joining the sections in a novel manner, so that the edges of all the sections are in alignment.

No. 1,690,452, MACHINE FOR THE MANUFACTURE OF WIRE SPIRAL, Patented November 6, 1928 by Jean Pierre Manent and Marius Manent of Lyon, France. This invention is an improvement over the present day method for the manufacture of wire spiral in that it winds the wire spiral directly on the thread and cuts it in any appropriate length without cutting the thread, thus avoiding considerable expense of hand-work.

No. 1,691,995, PACKING OF WIRE OR THE LIKE. Patented November 20, 1928 by Alfred Walter Saulter of Rotherhithe, London, England. A reel packet comprising a core member on and from which wire is adapted to be wound and unwound, and a pair of blanks of sheet material rigidly secured respectively to the ends of said core member, said blanks having lateral flaps foldable to produce a container to house wire wound upon said core member.

No. 1,692,030, WIRE INSULATION STRIPPER. Patented November 20, 1928 by Leon Friedman of Detroit, Michigan. A tool which may be used by electricians to rapidly and easily slit the insulating outer sleeve of non-metallically insulated cables.

No. 1,692,166, STRUCTURAL FORM TIE. Patented November 20, 1928 by Lee Orville Gates of Denver Colorado. This tie is especially intended for forms used in the construction of concrete walls for foundations and for buildings, or walls used as fences, dams or retaining walls and the like. This tie will not only act to tie the two side walls of the forms together, but which will also do the work of the spacers, and without the expenditure of any time by the workman, will act to properly position the boards of the side walls as they are put in place, and also to hold the side walls of the form out in place and prevent their falling inward prior to the pouring of the concrete, and thus save the time and expense of making and installing spacers.

No. 1,692,167, STRUCTURAL FORM TIE. Patented November 20, 1928 by Lee Orville Gates of Denver, Colorado. The present invention is an improvement over patent 1,692,-166 granted November 20, 1928 and discloses a wire tie with a stronger and stiffer cable portion, able to withstand the weight of a workman without excessive bending.

No. 1,692,993, WIRE ROPE CLAMP. Patented November 27, 1928 by George E. Lambert of Salem, Oregon, Assignor of one-fourth to James W. Duff of Portland, Oregon. A wire-rope or cable clamp adapted to a variety of purposes especially in logging operations; and which may be easily and conveniently applied or removed, and which will tend to hold the wire rope sections more tightly, the greater the strain imposed.

No. 1,691,043, WIRE DRAWING DIE GUARD. Patented November 13, 1928 by Harry Blount of Oak Park, Illinois, Assignor to Western Electric Company, Incorporated, of New York, N. Y. The primary object of this invention is to provide an efficient and reliable device for preventing accidental displacement of dies from a die supporting block of a wire drawing apparatus due to the whipping action developed in the trailing end of the wire.

No. 1,691,094, MACHINE FOR TWISTING WIRES WITH MATERIAL THEREBETWEEN. Patented November 13, 1928 by Anton Van Veen of West Hartford, Connecticut, Assignor to The Fuller Brush Company of Hartford, Connecticut. A machine relating to the class of machines employed for twisting strands of cotton or other fibers between wires for the purpose of forming dust mops or similar articles which is simple and efficient in construction and operation.

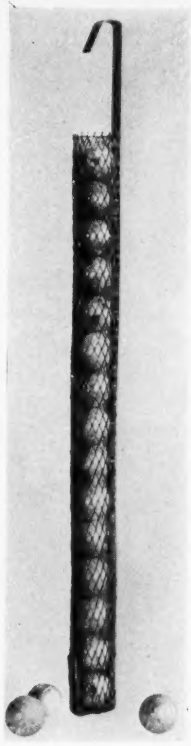
No. 1,691,159, WIRE BENDING MACHINE. Patented November 13, 1928 by George Franklyn Matteson of Rocky Hill, Connecticut, Assignor to The Fuller Brush Company of Hartford, Connecticut. A wire bending machine including a bending member rotatably mounted, a pair of formers projecting from said bending member and spaced for the reception of articles to be bent between them, means for operating said bending member to cause one of said formers to bend said articles around the other of said formers, a placer to place opposite ends of articles simultaneously between said formers, and means for supplying articles to said placer.

No. 1,691,166, WIRE FENCE MACHINE, Patented November 13, 1928 by Carl A. Porath of Kokomo, Indiana, Assignor to Kokoma Steel and Wire Company of Kokomo, Indiana. This machine is particularly adapted for manufacturing that type of wire fence in which use is made of horizontally extending strand wires, together with vertical cross stay wires suitably connected to the strand wires at the points of intersection.

New Wire Device for Cadmium Plating

A NEW type of anode, with wire cylinder container, for users of Udylite process in cadmium plating has been developed by the Udylite Process Co., Bellevue Avenue, Detroit. The anodes are made in the shape of a sphere and are used in a wire cylinder container which has a hook for suspension in the plating solution.

As old anode balls are used up, new ones are dropped in at the top, When corroded balls grow smaller they work toward the bottom of the container, leaving room at the top for fresh supplies. Advantages claimed for the method are that the anode area never changes; there are no studs to remove; there is no metal to pick out of the tank, and both anodes and container are clean and accessible.



The anodes of pure metal are cast in the form of balls of 2-inch diameter, weighing approximately 1¼ pounds each. To equip the wire containers, five-eights of a pound of anodes are required to each inch of container, which are made in seven standard lengths ranging from 18 to 36 inches.

New Annealing Pot for Wire

THE Fuzon annealing pot for wire, product of the Chicago Steel & Wire Co., is of welded stainless steel construction and is said to reduce annealing costs almost 50%. Although it weighs only 660 pounds, it takes the place of a cast steel pot and only requires the heating of 2660 pounds of metal, whereas the cast steel pot required 5300 pounds. At the annealing point of wire, which is 1350 to 1400 degrees F., this stainless steel shell has scarcely taken color and consequently there is no sign of scale on surface or interior, so the life of the pot is extended almost indefinitely.

The Fuzon pot is about 7 feet high and has an outside diameter of about 24 inches. The body is made of 18% chromium with 8% nickel stainless iron. It has a wrought steel base plate seven eights of an inch thick and a wrought steel collar on top about one inch thick. Eight carbon steel rods, one half inch in diameter, are welded to the collar and to the base to take the lift. A steel plate is welded inside so coils of wire can easily be removed and not catch in the corrugations of the outside shell.

The shell is of 14 gauge stainless iron, first formed and then riveted—the riveting being primarily for the purpose of retaining the proper shape and not to afford extra strength. One of these pots that has been in and out of the furnace approximately 75 times and up to the annealing point for several hundred hours showed no signs of crack or fracture under the microscope at the points where the stainless iron is welded to mild steel.

Steel Drums

for

Shipping Reels

WHY

have they been adopted as standard equipment by one of the large users of shipping reels

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Notes on Valve-Spring Design

(*Continued from page 12*)

mass of the spring. However if the design is good, springs designed for the same frequency will all come in, or surge, within a few vibrations per minute of each other. Hence, the formula is valuable for comparative purposes.

Design As Related To Natural Frequency

From our hypothesis of the nature of valve-spring surge, the obvious inference is that it is good practice to so design valve-springs as to obtain the highest possible natural frequency. This has been found to be true, within limits. Other factors, such as load and stress, being equal, a high-frequency spring is desirable since its wave-length is so high, compared with the wave-length of the disturbing force, that the spring will not vibrate in itself at the lower camshaft-speeds.

Another, and true, inference that can be drawn from the hypothesis is that surge, because of its nature, cannot be eliminated except by recourse to some sort of friction damper which might prove expensive and annoying. It must be expected that, in the present state of the spring art, a spring always will vibrate when the frequency of the disturbing force is an integral part of the frequency of the spring, provided the frequency of the disturbing force is high enough to cause the spring to vibrate of itself. This proviso suggests a possible solution of the problem. Why not so design valve-springs that their frequencies will be so high that they will not tend to vibrate until they have reached forced vibration or camshaft speeds in excess of those encountered in customary practice?

This idea of improving valve-spring surge conditions by increasing the natural frequency of the spring can best be illustrated by the study of an actual problem.

Data relative to the characteristics of two actual springs are given in Table 1. The spring whose characteristics are given in the column headed "Original" was found to have noisy vibrational periods when running in the engine, and, moreover, some cases of breakage in service were reported notwithstanding the low static-value of stress as shown in the table. It was proposed to supplant this spring by one whose characteristics are given in the last column of the table, and in which an endeavor was made to hold to the same approximate valve-loads but to increase the natural frequency of the spring.

It may be of interest to mention briefly the way in which this higher frequency of the spring is obtained by design. First, in this case, the pitch-diameter of the spring is decreased considerably, which tends to increase the rate of the spring. But to obtain the correct valve-loading and, at the same time, a reasonable free length, it is important that the rate be not increased excessively, hence the diameter of the wire is reduced somewhat, but the net result is a considerable increase in the rate.

Number of Coils Affects Rate

It should be noted that the number of active coils also affects the rate and that this number is varied to vary the rate. The weight of the active mass in the spring is decreased by reducing the diameter of the wire, the pitch-diameter, and the number of active coils. The increase of rate together with the decrease of mass effects a substantial increase in the natural frequency of the spring in accordance with Ricardo's formula.

The two springs mentioned were studied by means of the equipment designed for this purpose. Their surge characteristics were noted and a marked difference in favor of the redesigned spring was found. Surge periods in the original spring

were noted at camshaft speeds as low as 560 r.p.m. From this speed upward periods were noted at intervals obtained by dividing the spring frequency by whole numbers.

It was found, however, not only with this spring but also in other cases, that at some times a period of a certain camshaft-speed gave less surge and noise than the one at the next higher speed at which surge was noted. This is difficult to explain and does not harmonize well with the hypothesis presented as to the cause of surge. Perhaps the reason for this seeming discrepancy lies in the fact that the period of greater surge occurs at a speed which may be critical for one or more parts of the valve-gear, and that it is the resonant vibration of these parts, in addition to the spring, that causes the increased noise.

So far as the spring is concerned, the discrepancy does not invalidate the surge hypothesis, for, as pointed out, the observed periods corresponded closely, in a general way, with the calculated spring-frequency. The redesigned spring had no periods of appreciable magnitude until a camshaft speed of 1330 r.p.m. was reached, and at even this period the magnitude was so small that it was difficult to observe.

How Surge Affects Spring Stresses

Surge, if excessive, may cause the valve to float open and thus impede the operation of the engine or it may cause excessive hum and make an engine more noisy than it should be. In any case, it always causes, to a greater or less degree, a building up of stress which is deleterious to the fatigue-life of the spring. Upon this last premise we account for the phenomenal failures of valve-springs, as mentioned in the initial part of these notes.

Motion pictures reveal that, as the spring is vibrating in its own period, certain coils may, at a given instant, be compressed solid, while others may be opened up beyond their normal

Illustration shows Model 2L-00, 13 die Breguet High-Speed Wire Drawing Machine, which draws No. 36 Brown and Sharpe Gauge and finer sizes of copper wire at a finishing speed of 4000 to 4500 feet per minute.

EST. 1855 AIMco INC. 1918
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BREGUET HIGH-SPEED WIRE DRAWING MACHINES
Patents Applied For in the United States. Patented in France and Great Britain.
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The cut on the left shows a few of the thousands of the forms made on this
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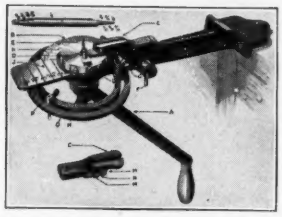

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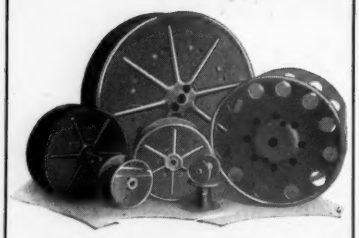

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(*Continued from page 25*)

position for an equivalent static compression by an amount which may be as great as or greater than a half pitch of the particular coil. At an instant one free wave later, the conditions are exactly reversed. Thus, while the stress range statically may amount to 15,900 lb. per sq. in., the stress range in vibratory operation may vary between zero and solid stress, or even greater than the latter, depending upon the amount of impact due to coil clash.

To be a little more specific about this stress range, the stresses on the spring whose natural period was 10,750 free vibrations per minute ran as follows:

	Stress, Lb. per Sq. In.
Spring compressed solid	69,000
With valve open	42,200
With valve closed	25,300

When this spring is vibrating severely in its own period, the coils which are closed and clashing will be stressed 69,000 lb. sq. in., or even more, depending upon the impact value of the coil clash. At the same instant, a coil at the opposite end of the spring will be opened up a certain amount, due to the wave motion. If the latter coil is opened up an amount which will make its pitch at that instant equal to its pitch when the spring is in a free or totally unloaded condition, then the stress range will be 69,000 lb. per sq. in. or more. This, however, is a very extreme case.

It is especially important to remember that the rapidity with which this stress range is passed through is of an order much greater than camshaft speed. For example, in the case of the spring mentioned, which has a natural period of 10,750 free vibrations per minute, the entire abnormally high stress-range will pass from the maximum to the minimum value in 0.00558 sec., or in the time for the wave to assume a position exactly out of phase with its former position.

From the foregoing discussion it can be seen that the ef-

fect of surge upon a valve-spring is to bring about:

(1) Existence of a maximum stress of a higher value than that calculated by the conventional formula.

(2) Occurrence of a higher stress-range in the end coils than that calculated on a static basis.

(3) A state whereby the stress-range is traversed with great rapidity.

All investigations along the line of metal fatigue tend to show that fatigue life is a function of the maximum stress existing, the stress range through which the material is worked, and the total number of oscillations to which the material is subjected. Accordingly, the abnormal stress conditions and the abnormal rapidity with which the stress range is crossed, due to the surge, tend to accelerate greatly the fatigue of the spring.

Four Contentions Advanced

These notes suffice for us to advance four major contentions relative to the general subject of value-spring surge.

(1) Valve-spring surge is a product of a resonant condition between the rate of the forced vibrations, due to the camshaft, and the natural frequency of the spring.

(2) Surge cannot be eliminated in the present type of spring, as the tendency to vibrate is an inherent characteristic of a spring. A solution is offered, however, by designing springs for high frequency so that they will not vibrate until they are subjected to rates of forced vibration in excess of speeds above the range of normal maximum camshaft speeds.

(3) Surge is affected by the design of the valve-gear. A tendency to magnify spring surge may exist if one or more parts of the valve-gear are also in resonance with the spring.

(4) Surge is a prolific source of valve-spring failure, due to the stress conditions and the rapidity of the stress cycle set up by the surge.

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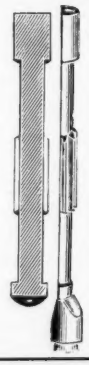

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Wire Rope and Safety

(*Continued from page 14*)

made by using more clips than by applying a few in such a manner that the rope is crushed.

Clip connections on new lines should be watched very carefully until the line takes its stretch. As the strands adjust themselves under load and compress the hemp center, the rope decreases in diameter, thus loosening the clips. The contractor's standby, much maligned by safety men as being dangerous, is far more efficient and dependable than some clip connections commonly found on construction work. While the half-hitch kinks the line and reduces its strength probably 50 per cent, the connection is dependable up to this limit even when applied in a relatively careless manner and the load on the line rarely reaches 50 per cent of its ultimate strength.

Accidents in which wire rope is a factor are not limited to those caused by the failure of the line itself. Our state records show that accidents due to wire rope failures are quite infrequent, there being only one in the construction industry this year. In this case a boom line on a derrick parted and two men were struck by the falling boom.

There are others, however, in which wire rope is a factor but not the cause of the accident. Recently a laborer on an operation in Cincinnati was killed when a splice in a hoist line made with one clip failed, allowing the platform of the inclined hoist to run to the bottom of the incline, crushing the workman against a pile of lumber.

Accidents of this kind are of sufficient frequency and severity to warrant the constant attention of the safety engineer. Some contractors put their sheaves up out of reach and provide barriers for all running lines near the floor or ground. Rules of standard practice governing the use and care of wire rope and the various types of connections should be made available to every user.

Wire and Rod Requirements in Gas Welding

(*Continued from page 20*)

welding metals, fluxes, carbon blocks, moulding compounds or refractory pastes, solders, etc., and if this plan is followed, one of the most important factors of good welding practice will be fulfilled.

The accompanying table presents a list of metals, together with welding materials or filler materials that apply to them as determined from successful commercial applications either in the welding together or the building up of metals as the method applies.

The foregoing metals are packed in convenient containers or wrapped in heavy burlap for shipment to the consumer. Each class of material is either stamped with the manufacturer's name or trademark and the bundles properly tagged to avoid any confusion of material and every precaution taken by reputable manufacturers to deliver the material to the consumer in an untarnished condition.

All of the foregoing are the usual standard materials found in the industry. There are cases where it is desired (for instance, in low carbon steels) that a higher tensile strength be obtained. Recommendations and materials are offered by several competent manufacturers for this purpose.

There are also other cases where it is desired to weld several metals of both the ferrous and non-ferrous group. This should only be performed under competent welding and metallurgical advice, as it is possible always to secure suitable welding material for the problem at hand.

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Observations on European Rod and Wire Drawing Practice

(*Continued from page 15*)

higher quality bars and lower scrap losses. The opinion as to the success of the new process was by no means universal and at least one large German producer has condemned the scheme. In Germany and Switzerland we found a movement to mechanical vertical extrusion presses for the extrusion of the smaller sizes of brass and copper tubing.

Throughout Continental Europe a new German type of automatic screw machine is replacing a popular American type rapidly. This same type has already made its appearance in this country and over twenty are in use in the factories of the Western Electric Co. This German concern is selling its machinery in this country by placing a machine with an expert in a plant indefinitely to demonstrate the features of their equipment. We visited their factory and were greatly impressed with the high quality of engineering talent and workmanship employed.

European countries suffer from too great a number of small companies competing in the same field. There are probably four or five times as many brass plants in Europe as in America. As a result some are so small that they cannot justify the expenditure required for modern equipment. It is apparent that it is quite common for manufacturers to try to keep their plants busy by unloading part of their production on other countries at practically cost. As the practice appears to be quite generally followed, the consequences are rather demoralizing. This difficulty has been accentuated in the metal industry by the increases in plant capacity made during the war. Such conditions cannot continue to exist indefinitely, and we came in contact with evidence that the correcting economic influences are at work.

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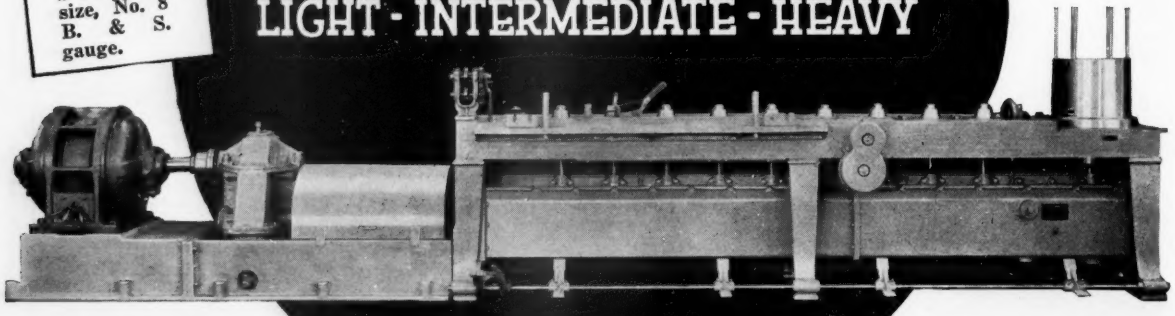

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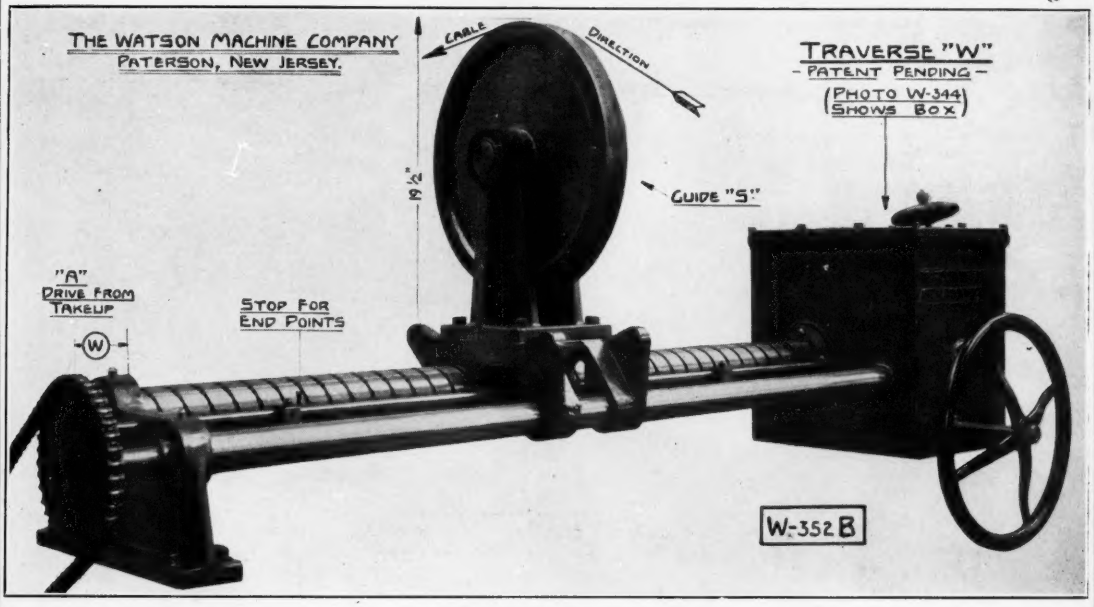


TRAVERSE "W"

A Power Traverse, driven from takeup reel drive, places all the elements of control as nearly as practicable at one point. All adjustments; End points (for width of reel), Lay, and Transfer of power to Hand control, can be made while in operation.

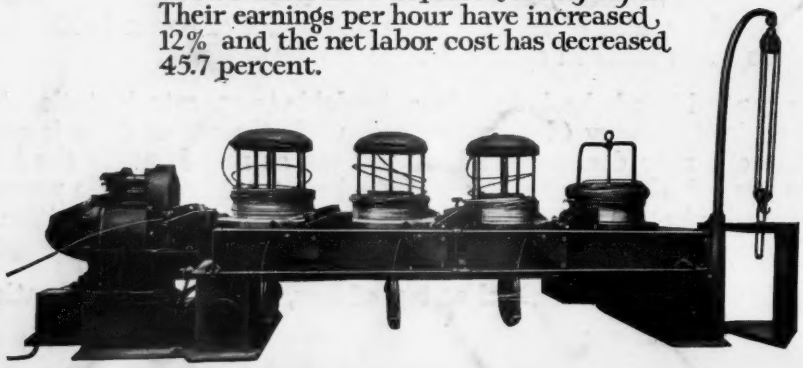
The control handwheel shaft is extendable to operator's station. This handwheel is stationary (does not rotate) while the power drive is active. When the operator desires to adjust lay (as at reel flanges) the handwheel is pushed **three** inches toward the box, transferring the power to hand control of screw. Withdrawal of handwheel to initial position after adjustment is complete, again connects the power drive.

Lay is varied by handwheel at top of box, giving variation ratio of 16/1 in even increments.

ELECTRICAL WIRE AND CABLE
WIRE ROPE and CORDAGE MACHINERY

MORGAN
WORCESTER
ENGINEERS AND MANUFACTURERS

Through this installation of
Morgan Connor Wire Machines
twelve men have replaced *twenty-eight.*
Their earnings per hour have increased 12% and the net labor cost has decreased 45.7 percent.



MORGAN CONSTRUCTION CO.
WORCESTER, MASSACHUSETTS, U.S.A.